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But we must reach Amecameca by dark, as in traveling through the woods after twilight we might fall in with objectionable company.

At twelve o'clock we began the descent, and it reminded me strongly of the twenty minutes' descent or run down Vesuvius. After zigzagging down over the snow and ice, now quite yielding, stopping frequently to rest one's tired knee-joints, on reaching the sand below the snow fields, my two *guias* each took one of my arms and we ran down the long sandy slope arm-in-arm. We reached La Cruz by about two o'clock, and walking on a mile or so more down the slope, I found a horse which Mr. Ober had sent me, in waiting. Reaching the ranch at about three, after half an hour's rest and refreshment, Mr. Ober and myself rode with our guide Rafael fifteen miles to Amecameca, while our *guias* trotted the whole distance on foot behind their pack mules.

Nothing is more monotonous in its flatness than a Mexican bedstead, while the mattress is only thicker than a Mexican blanket, the bed being but a little more yielding than the soft side of a pine board, but that night—spent in a second-class Mexican hostelry, after such a long day's work with the alpenstock and in the saddle, half frozen in the morning on the mountain side and half roasted in the hot mountain gorges and on the dusty plains in the afternoon,—that night was given without reservation to the worship of Morpheus. The next day at ten we reached the site of ancient Tenochtitlan, rested in the grand plaza under the shade of the orange and banana, by the plashing fountain, our eyes feasting on the varied, ever-changing pictures of Indian, Mestizo and Spanish types of Mexican life passing before us in that famous square.

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NOTES ON THE CECODOMAS, OR LEAF-CUTTING ANTS, OF TRINIDAD.

BY C. BRENT.

AN opportunity was afforded me during the winter of 1884-5 for studying the life and habits of this most interesting species on the Island of Trinidad, West Indies. Several species are here distinguished; all, however, are alike in form and habit, the variety being produced by variation in size and color. These insects are extremely numerous, indeed one cannot take a walk anywhere in the country without observing broad columns of

seemingly animated leaves marching across the roads. Complaints are heard on every hand of their ravages among the gardens and plantations. Agriculture is all but hopeless in sections infested by these pests, since although they occasionally attack one of the forest trees, they show a decided preference for the leaves of cultivated trees and garden plants, the cocoa, coffee and orange being particularly subject to their destructive visits. They seem also to develop a "penchant" for particular trees. One orange tree in a grove of the same species is stripped again and again, while the neighboring trees are left untouched. The curious habit these ants possess of cutting and carrying off immense quantities of leaves, has often been noted in books on natural history, although the question is still an open one as to the object of the custom and the disposal of the cut leaves. My own observations on these points I shall give farther on.

The speed with which these little workers operate is indeed marvelous. A good sized mango tree, at least as large as an average apple tree, I saw stripped of every leaf in one night, and greater feats than this are recorded of these "*Tourmi Ciseaux*," as they are called by the Creoles. In the morning the naked boughs bore only the bare midrib of the leaves with here and there jagged portions of the parenchyma left by the circular pieces snipped off. The ground was littered with circular pieces of leaves about the size of a ten-cent piece, which the ants had neglected to carry off. Old leaves and young had alike been snipped off, but most of the pieces left were cut from the older leaves.

During the day I discovered the formicarium to which these ants belonged, some three or four hundred yards up the mountain side. It was situated on a gently sloping incline covered by a dense "*vastrajo*," or second-growth wood. The site of the hill had been well chosen in a spot free from large trees, and the smaller bushes had been removed, leaving the soil as bare as if the vegetation had been destroyed by a fire. The mound was of immense size, being about forty-five feet across and about two feet high. The soil was of a different color from that of the surrounding hillside, and consisted, I found, of clayey granules brought up by the ants from the subsoil below. No signs of ants were visible, nor were any recently used entrances to be seen. Several tunnels extended a short distance into the mound, but

they were all *stopped* up by soil washed into them by the deluging rains that had been falling for several previous days. Cutting my way through the bushes by means of that useful and indispensable part of a forester's outfit for tropical woods, the "machete" or cutlass, I found, some twenty yards up the hillside, an entrance from which led, as far as the eye could see, a wide smooth path, worn by repeated travel some five inches deep, and carefully cleaned of all vegetation, dead leaves and rubbish. A few yards from the entrance a huge tree had fallen but recently across the pathway, but the industrious insects had dug a tunnel six inches in diameter under it in preference to climbing over it or making a new path around it. A little farther on I met another instance of formic ingenuity. The path led to the edge

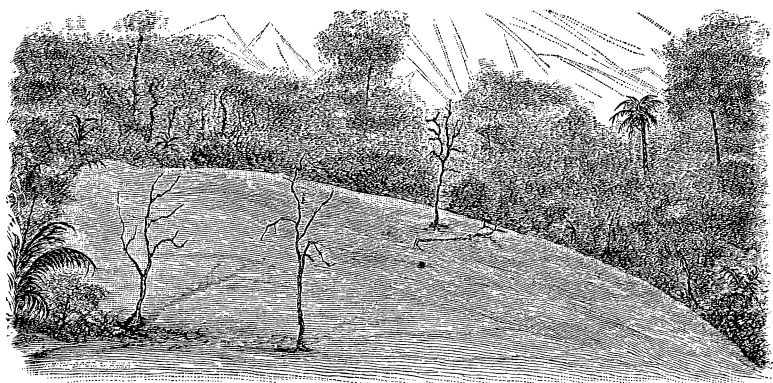


FIG. 1.—An *Ecodoma formicarium*. The cleared space is forty-five feet in diameter.

of a ravine where it branched; one branch led directly across the ravine, down the precipitous sides of which an oblique path had been excavated at an angle of about 45° ; the other branch led up the edge of the ravine some twenty yards to a fallen tree which spanned it. Over this the pathway led to the opposite bank, down which it ran to join the direct path below. I subsequently noted that during the rainy season when the ravine held a stream of water, the ants toiled up the hillside to their bridge, but as soon as the water dried up they used the nearer path directly across the ravine. On looking around the mound I found five other entrances to the formicarium, all at some distance from it, and from each of these diverged a pathway through the woods. Along one of these traveled a dense column of ants, those

outward bound keeping the right hand side, while those returning home traveled along the left. The incoming ants were nearly all laden with their leafy burdens which they carried tightly gripped between their mandibles, sometimes nearly upright, or thrown back so as to completely hide the insect below. This curious fashion of carrying the leaves has earned for them the common English name of "parasol" or "umbrella ants."

Along the path were several heaps of leaves, which were probably carried away by a fresh relay of workers; often these heaps may be noticed lying deserted along the pathways, but they are invariably removed, sooner or later, to the nest. The leaves



FIG. 2.—Ants at work leaf-cutting.

were those of the cocoa, so I traced the column down the hill-side some four hundred yards to the edge of a cocoa plantation, where I found them actively engaged in leaf-cutting. The smaller trees were swarming with the little depredators, leaves were falling plentifully as the little sawyers snipped them out. Numbers of ants marched up the tree and numbers marched down, very deftly managing their awkward-looking burdens. Sometimes they progressed sidelong down the tree, sometimes backwards, according to the condition of the surface over which they walked.

In operating on a leaf the ant places herself upon the upper

surface near the edge, and saws a circular cut nearly all the way round with a saw-like motion of her finely serrate mandibles. To prevent the section falling she does not saw it all round, but when nearly severed seizes it by the edge and by a sharp upward jerk detaches it. Now she either marches directly off to the nest or lets the fragment drop to the ground and begins sawing another. Often quite a heap of pieces accumulates beneath the busy little sawyer.

The *Cecodomas* are differentiated, as in other species, into males, females and workers, the latter being of course undeveloped females. Four classes may be distinguished among the workers, only two of which take part in the foraging expeditions.

The majority of these workers are of a pale reddish color with a



FIG. 3.—*Cecodoma* of Trinidad, male.

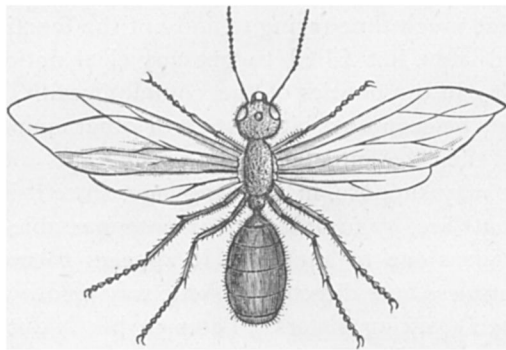


Fig. 4.



Fig. 5.



Fig. 6.

FIG. 4.—Female. FIG. 5.—Worker major, or so-called soldier. FIG. 6.—Worker minor. All natural size.

stout body, short round unpolished head, which carries behind a

pair of spines. The thorax is very sharply constricted in the middle, the fore part, or prothorax, carrying the first pair of legs and a pair of spines upon the dorsal surface. The hinder part, or meso-metathorax, carries the other pairs of legs and two pairs of spines. The cutting instruments are a pair of long extremely sharp-pointed mandibles finely serrated upon their inner surface, which may be used as saws or nippers. The workers vary extremely in size; individuals are met with only three-sixteenths of an inch in length, while others attain a length of nine-sixteenths. These smaller (younger) ants accompany their older sisters in their expeditions but rarely carry leaves. They may often be seen riding upon the burdens of their older and larger sisters as if tired. I have observed as many as three clinging to a leaf which was carried with apparent ease by one of the larger ants. A number of these little ants may be observed to issue from the mines with the old ones and loiter around the entrances as if as yet unable to take part with the stronger ants.

Here and there among the mass of workers, perhaps forming about one per cent of the total number, may be seen a much larger, formidable-looking ant with enormously swollen triangular head, which takes no part in the work, but always accompanies the "worker minors," as they are called, on their expeditions. I spent much time trying to find out the functions of these large-headed ants, but failed to get any clear notions as to the part they play in the politics of the commonwealth. They may nearly always be seen on a bit of stick or other eminence, caressing now and then the antennæ of the passing ants with their own. Talking, we may suppose, in ant language, since it is well established that ants are, by means of their antennæ, able to communicate their ideas one to another. It appears to me that these apparently useless ants directed in some way or other the movements of their working sisters. Bates in his *Naturalist on the Amazons*, came at first to the same conclusion, but afterwards abandoned this idea for one I think not more tenable, namely, that these ants by their superior size draw upon themselves the attacks of ant-eating birds, &c., being thus, as he terms it, merely "pieces de resistance," thus only serving to preserve the main body of workers by a self-sacrifice of mere "passive" resistance.

I went to the trouble to shoot several ant thrushes and Den-

drocolaptes which feed almost entirely upon ants, to see if there was any foundation for this theory, but found very few indeed of the so-called "worker majors," although the crops were distended with "worker minors." In other works on natural history they are termed "warriors," but they by no means correspond to the warrior or soldier class in the Termites, for instance. They have no special offensive or defensive weapons, their movements are more sluggish even than those of the smaller ants, and when the nest is disturbed by poking it with a stick, the smaller ants only prove pugnacious. In the battles which so often occur between the mail-clad bandits of Trinidad forests, the savage "Ecitons," or "hunting ants" and the "parasol ants," the brunt of the fight is borne by the "worker minors" who always drive off the marauding Ecitons.

In some *Ecodomas* there is a series of intermediate forms between the working minors and the working majors, and in some species all take part in leaf-cutting. Besides these workers there are two other classes, which never leave the mines, the worker nurses, to be distinguished from the working minors chiefly by their hairy heads, and another class of very large ants, individuals of which are found nearly an inch in length. This class is represented in each formicarium by only a few individuals, which are distinguished by their large hairy heads and the possession of a twin ocellus placed in the middle of the forehead. These never leave the mines, and are seen only when the formicarium is opened.

The ant hill referred to above being a pest to the neighboring plantations, it was determined to destroy it. Poisons were found useless. Corrosive sublimate and potassium cyanide were mixed with farina and deposited near the nest. These were simply ignored; the ants would not touch them after a few had fallen victims. A solution of arseniate of soda was next sprinkled upon orange leaves, which were strewed upon the mound. These were eventually cleared away, although at an immense sacrifice of life. This points, I think, to the true ant food, since unless the juices of the leaves as they were sawed up were swallowed, the poison would have had no effect. This idea is strengthened by the fact that fiery and strongly aromatic plants as well as those with poisonous, milky juices are carefully avoided. No solid food is found in the crops of the insect at any time, but if

these are examined after the insects have been engaged in leaf-cutting, they are found full of green leaf juice. Finally we destroyed the nest by drowning, the common method during the wet season. A number of channels were dug in the hillside, all constructed to collect the rainwater as it streamed down the hill, and to pour it into the nest by one of the entrances. I visited the nest during the next rain to see how the plan was working, and was surprised to find the water pouring out of an orifice twenty yards below the nest. After the rain I examined this tunnel and found that it entered the nest at the lowest point, some eight feet below the surface. I examined many formicaria subsequently, and invariably found this lower tunnel wherever the inclination permitted its construction. I have no doubt that it is constructed as a drain, and that the ants know as much about the advantage of thorough drainage as they have been proved to know, by many eminent observers, of those of other sanitary matters. On opening the mound, some three feet below the sur-

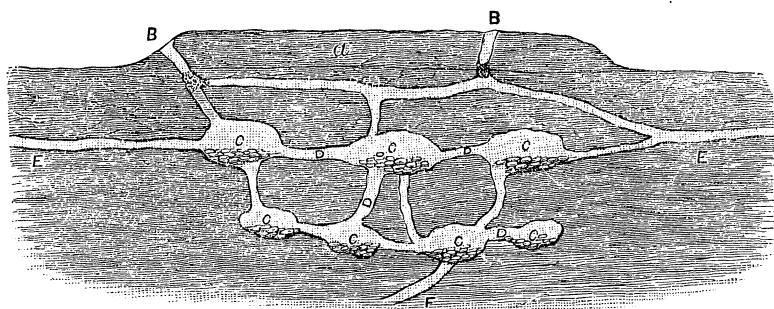


FIG. 7.—Diagrammatic v. section of an *Ecodoma* formicarium, depth about eight feet. *a*, mound of clayey granules; *B*, unused entrance; *C*, chambers containing leaves; *D*, connecting corridors; *E*, tunnels to distant entrances; *F*, drain from lower level of mines.

face was found a series of hall-like cells, some three feet in their larger diameter, connected with each other by short smooth corridors. From the outermost of these proceeded the tunnels communicating with the surface by the orifices mentioned above. Below there was a second series of somewhat smaller cells, the lowest of which was entered by the drain just referred to. The central chambers were all washed out, but several of the lateral chambers had escaped damage. In these were found bushels of leaves, several of the large cyclopean ants, many nurses, larvæ, and an *Amphisbæna*. This lizard is generally a guest of the

parasol ants, and repays their hospitality by feeding upon them. The natives firmly believe that the "serpent a deux tetes," as they call it, is the mother of the ants, and that they procure the leaves for the purpose of feeding it.

The larvæ were imbedded in a soft woolly matter which proved to be the finely masticated parenchyma of the leaves. Thus a use was found for the leaves, although it reflects seriously upon the supposed sagacity of the ants that they should procure so many more than are required for the purpose. Bates states that the leaves are also used for thatching the domes over the entrances to the mines, but I have not observed this practice in connection with the Trinidad species. The larvæ are fed by juices secreted by the nurses. A part of the larvæ emerge from the eggs winged and ready for their nuptial flight. These are the males and females, and the swarming occurs during the wet season. The female measures an inch in length and two inches in expanse of wing. The wings are clear, transparent and coarsely veined. The winged males and females emerge from the woods in clouds during the rains of April and May. These are almost all destroyed by the flycatchers, jackamars, ant-thrushes, &c., which greedily devour them; only a few impregnated females survive the slaughter to found new colonies and propagate their race. The colony is sustained, I suppose, as in other species, by the seizure and detention of impregnated females by their own subjects. After impregnation the female loses her wings, these being broken off by the insect itself. There may be noticed a natural suture at the base of the wing, doubtless that this may be easily broken off when no longer required.

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THE TEREDO, OR SHIPWORM.

BY R. E. C. STEARNS.

THERE are several species of what are popularly called "shipworms" which are ordinarily included under the name *Teredo*. Although to the common observer they have a worm-like appearance, they are not worms, but true shell-bearing mollusks, as much so as the common "long clam," "long-necked clam" or "mananose" (*Mya arenaria*) of the Atlantic coast of the United States.

So much has been written in relation to the shipworms that it